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AUTHOR Byrd, Ronald
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ABSTRACT

A recent survey of physical educators reveals that physical development--especially its more specific parts dealing with physical fitness--is thought to be the least important physical education objectives for grades K-2. Research is available on physical fitness as it relates to (1) incidence of childhood obesity, (2) cardiovascular endurance, (3) differential treatment of the sexes, and (4) participation in contact sports by children. There are strong correlations between weight and activity level and between triceps skinfold thickness and activity. Dieting alone has proved an ineffective approach for the obese, and it results in significant loss of lean body mass in addition to fat. Physical education then should place more emphasis on cardiovascular endurance fitness than on conventional athletic games. Until recently it was felt that the preadolescent was constitutionally unsuited for activities that put a heavy demand on the cardiovascular system, but pediatric exercise physiologists and coaches have discovered an unusually high potential for performance and training in youngsters. Physical educators have been slow to accept this. Boys tend to be stronger than girls when matched for height at any age, but only minor functional differences exist prior to puberty. It is nearly impossible to determine how much of the advantage boys enjoy is a result of social conditioning. Finally, contact sports for children should not be feared but can offer much to their overall development under proper conditions. (DMT)

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WHAT RESEARCH TELLS THE PRACTITIONER ABOUT THE EFFECTS OF EXERCISE ON CHILDREN

Ronald Byrd
University of Alabama in Birmingham

A recent study revealed that physical development was thought to be the least important physical education objective for grades K-2 (Gordon, Thompson, and Alspaugh, 1973). Certainly we can't argue against the importance of mental, social, and other developmental objectives, but the place of physical development in our hierarchy of values appears paradoxical. This is especially puzzling when we consider that this was a survey of physical educators. If we are not concerned over physical development, who will be?

Of further interest in this particular study is the fact that within the least important objective, physical development, the more specific parts dealing with physical fitness were considered to be the least valid. This springs, in part, from the assumption that through their natural activity children will develop and maintain fitness. Certainly when compared to their parents, children are fit. In addition, research has shown no differences between American and Swedish youngsters on tests of physical working capacity (Adams, Bengtsson, Berven, and Wegelius, 1961). We must not be complacent, though. Exercise physiologists are quite aware of the serious deficiencies in physical fitness that adult Americans exhibit in comparison with Scandinavians. Thus, while we suffer no genetic disadvantage from a position of equality in fitness from birth through the early school years, an ever-widening gap appears around adolescence and continues into adulthood through the middle years into old age.

Why does this occur? Could it have to do with life styles? Could attitudes toward physical fitness be a factor? Could our failure to teach the hows and whys of fitness be involved? Do we really understand the scientific bases of physical activity and its effect on children? This symposium and this presentation are aimed at answering some of these questions. The application towards behavior modification is up to you practitioners, the most important link in the chain.

Let's consider what research has for the practitioner with respect of children's fitness and: (1) incidence of childhood obesity, (2) cardiovascular endurance, (3) differential treatment of the sexes, and (4) participation in contact sports.

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Obesity

It is generally accepted that fat babies tend to become obese adults. Rose and Mayer (1968)found strong correlations between weight and activity level, and between triceps skinfold thickness and activity. Interestingly, they found insignificant, low correlations between calories consumed and weight, emphasizing the importance of constitutional factors. Heredity is certainly involved in cases of childhood elevated serum cholesterol and hypertension, as well as in obesity. Serum cholesterols in excess of 200 mg/100 ml were found in 28% of 613 health Australian boys between 11 and 18 years of age (Hickie, Sutton, Russo, Ruys, and Kraegen, 1974). Figures for Vermont, Iowa, and Wisconsin were 13% (Clark, Merrow, Morse, and Keyser, 1970), 15% (Hodges and Krehl, 1965), and 33% (Golubjatnikov, Paskey, and Inhorn, 1972), Wilmore (1975), and Boyer (1974) cite high incidence of elevated blood lipids, obesity, hypertension, and low work capacity as indications that coronary heart disease may be seen as a pediatric problem. The need for early intervention is emphasized by Parizkova, Vaneckova, Sprynarova, and Vamberova (1971) who found more success in directing obese children to weight loss prior to puberty. The importance of physical activity must be stressed. While exercise is not a cure-all, the beneficial effects of regular strenuous activity on some cases of hyperlipidemia and hypertension, the resultant increase in basal metabolic rate in most subjects, and the increased caloric expenditure and work capacity in all cases makes this a preferable mode of weight reduction. Dieting alone is a very difficult approach for the obese and results in significant loss of lean body mass in addition to fat. Boyer (1974) suggests that physical education should put emphasis on cardiovascular endurance fitness rather than on conventional athletic games.

Parizkova and others (1971) recommend instruction or counselling of the obese in matters such as nutrition and proper activity. These are certainly approaches that we physical educators should consider taking in an attempt to deal with this mounting problem. Let's give adequate attention to this population which needs us more than the normal, the healthy, the athletic children.

Cardiovascular Endurance in Children

Until recently, it was generally held that the preadolescent was constitutionally unsuited for activities that put a heavy demand on the cardiovascular system. While pediatric exercise physiologists and coaches of age-group swimmers and tracksters have discovered a previously unheard of potential for performance and for training, physical educators have been slow to accept the innate ability of these youngsters for endurance activity.

Children do not naturally stress the cardiovascular system to the degree necessary for physiologic adaptation as is generally believed. In a survey of 12 year old children, Seliger, Trefney, Bartunkov, and Pauer (1974) reported that heart rates of over 150 were rare and fleeting occurrences. Bailey (1973) stated that:

> "...physical fitness expressed by aerobic power factoring out size, seems to be a decreasing function of age from the time we put him behind a desk in our schools".

With the recent attention to the trainability of young children, there has been much conjecture and some evidence that children might be more susceptible to training during the adolescent growth spurt (Asmussen, 1973; Ekblom, 1971). That eventual adult limits might be affected by endurance training at this time has been seriously considered (Bailey, 1973; Bailey, Bell, and Howarth, 1971).

Recognizing that both resting heart rates and maximum heart rates of children are higher than those of adults, it naturally follows that threshold and optimal training heart rates will be higher also. Further, the entry fitness level is likely to be slightly higher than that of adults, requiring a greater stimulation for adaptation to occur. Massicotte and Macnab (1974) suggest that the training heart rate for 11-13 year olds should be 75% of the heart rate range rather than the 60% suggested by Karvonen (1959) for adults.

A few precautious are in order for those working with preadolescents. First, children who are suffering any illness should be barred from strenuous activity. Problems of immature judgement and positive motivation could cause serious complications. Second, prepubertal children do not tolerate heat stress as well as do older children and adults (Lofstedt, 1966; Wagner, Robinson, Tzankoff, and Marino, 1972). Thus exercise in a hot environment could pose a serious physiologic problem. Finally, participants, whether child or adult, in any strenuous activity should have medical clearance and should be closedly supervised. During exercise sessions, particular attention should be given to undue fatigue, nausea, pallor, and chest pain, all of which could be indicative of coronary insufficiency. Tragically, even moderate activity sometimes takes the lives of young as well as old exercisers. Anomalies of the coronary arteries are often involved and generally there is a history of symptoms that have been ignored (Adams and Sato, 1974; Jokl, 1971).

Sex Differences

Though only minor functional differences exist between girls and boys prior to puberty, it is difficult if not impossible to determine at this time how much of the advantage that boys enjoy is a result of social conditioning.

Although acceptance of girls' full participation in physical activities is imminent, equality in exposure and opportunity is not yet a fact.

Boys tend to be stronger than girls when matched for height at any age (Assmussen, 1973). This means that girls might equal or surpass boys in absolute strength during growth spurts. Assmussen believes that both sexes are naturally accustomed to a lower degree of strength utilization in ordinary activity than are adults and thus might be more trainable. With equal motivation and a similar history of past activities, some of the prepubertal advantage in strength of boys might disappear. For development of strength or muscular endurance, both sexes should apply standard techniques and principles of specificity, overload, and progression just as for older children or adults.

Davies, Barnes, and Godfrey (1972) found no sex differences up to age 13 in V_E max, VO_2 max, or LA max. Adams, Bengtsson, Berven, and Wegelius (1961) disagree, finding differences to appear at an earlier age. Nonetheless, previous activity, social expectations, and motivation were probably operant in all of these cited studies. That young girls can and should participate in any sport or physical activity that boys are allowed is definite. It remains an open question as to the ultimate, if any, differences between boys' and girls' sports performances prior to puberty.

Contact Sports

In 1956, the American Academy of Pediatrics officially opposed contact sports for preadolescents. This decision was made primarily on the basis of open, vulnerable epiphyses (Thornton, 1974). The statement was embraced by most mothers, accepted by few fathers, and violently opposed by all football coaches.

Larson and McMahan (1966) examined 1,338 athletic injuries and found only 6% in the 15 year and younger group to be epiphyseal. They emphasized that such problems do not necessarily mean permanent deformity or growth disturbance.. The real hazard is failure to recognize the problem and provide treatment. Children more susceptible are the obese and the tall, uncoordinated youth with poor muscular development. With proper rules, supervision, and medical attention, there is no objection to participation in contact sports by preadolescents. Such organized competition is certainly preferable to the alternative, unsupervised sandlot play with no officials, poor or no protective equipment, and no coaching or medical attention.

Summary

The International Council of Sport and Physical Education's Declaration on Sport, UNESCO, Paris (1964), reads:

> "An individual, whatever his ultimate role in society, needs in his growing years a due balance of intellectual, physical, moral and aesthetic development which must be reflected in the educational curriculum and time table...Between 1/3 and 1/6 of the total time table should be devoted to physical activity."

Our attention in physical education should be primarily to physical development, with at least as much consideration of fitness as of other factors. We face a real problem in combatting obesity and related coronary heart disease risk factors appearing in early childhood. We must realize that children are capable of much greater levels of endurance stress and performance than is generally thought and that girls must not only be given equal opportunities, but actively encouraged to overcome outdated societal attitudes toward females and physical activity.

Finally, contact sports for children are not to be feared, but can offer much to their overall development under the proper conditions.

Implicit in this presentation is a dual challenge, first to researchers to continue seeking answers to a seemingly never-ending supply of questions on exercise and children, and second, to those of you who are practitioners, to accept and apply the results of this and future research in attempting to provide our youth with the best possible physical education.

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